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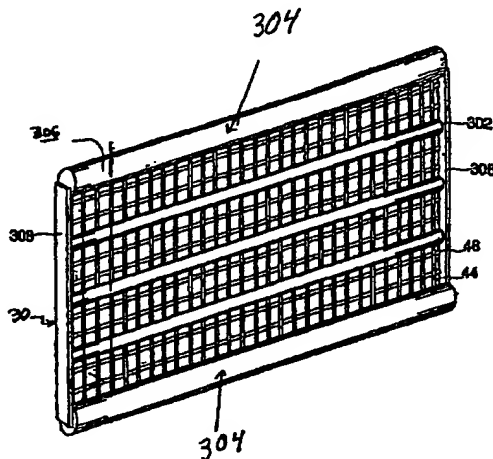
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[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR MAINTAINING SPACING BETWEEN TENSION FOCUS MASK STRANDS
IN A TENSION FOCUS MASK



(57) Abstract: A method and apparatus of maintaining spacing between tension focus mask strands (44) in a tension focus mask (30) in a cathode ray tube (10). The method of making the tension focus mask includes steps of providing a mask frame (306) having vertical strands attached thereto; applying permanent adhesive to a screen-side of the mask strands; affixing at least one novel non-permanent horizontal guide member (302) to a gun-side of the mask strands with a non-permanent adhesive; applying crosswires (46) to the screen-side of the strands; and thermally processing the apparatus, thereby (1) permanently attaching the crosswires to the mask strands and (2) volatilizing the adhesive on the gun-side of the mask strands such that any non-permanent guide members detach from the mask strands. The guide members maintain the vertical mask strand during: (1) the application of the horizontal crosswires to the screen-side of the mask and (2) the subsequent thermal processing.

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**METHOD AND APPARATUS FOR MAINTAINING SPACING
BETWEEN TENSION FOCUS MASK STRANDS IN A TENSION FOCUS MASK**

This invention generally relates to color picture tubes and, more particularly, a method and apparatus for fabricating tension focus masks for color picture tubes.

BACKGROUND OF THE INVENTION

A color picture tube includes an electron gun for forming and directing three electron beams to a screen of the tube. The screen is located on the inner surface of the faceplate of the tube and is made up of an array of elements of three different color emitting phosphors. A color selection electrode mask, otherwise known as a shadow mask, is interposed between the gun and the screen to permit each electron beam to strike only the phosphor elements associated with that beam. A shadow mask is a thin sheet of material, such as steel, that is contoured to somewhat parallel the inner surface of the tube faceplate. A shadow mask may be either formed or tensioned. There are three types of tension mask systems: (1) strand tension mask; (2) tie bar tension mask; and (3) tension focus mask. A tension focus mask comprises two sets of conductive members that are perpendicular to each other and separated by an insulator. The two sets of members are held at different voltages; thus, creating electron focusing lenses within each rectangular space encompassed by two adjacent mask strands and two adjacent crosswires. A tension focus mask has at least one of the sets of conductive members under tension. Generally, in a tension focus mask, a vertical set of conductive members or mask strands is under tension and a horizontal set of conductive members or crosswires

overlies the mask strands.

In assembling a tension focus mask, it is required to assemble the crosswires and mask strands with a high degree of accuracy to achieve consistent spacing between the mask strands and between the crosswires. If the spacing between vertical mask strands is consistent, then the tension focus mask will not exhibit macroscopic streaks, and as such, those macroscopic streaks will not be printed into the matrix and screening array.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for assembling a tension focus mask and maintaining uniform spacing between the vertical members, or mask strands, of the mask. The method includes providing a tension focus mask comprising vertical mask strands which are held in tension. A permanent adhesive is sprayed on the screen-side of the mask strands followed by the attachment of horizontal guide members to the gun-side of the mask strands with the use of a non-permanent adhesive. Next, permanent horizontal crosswires are applied to the screen-side of the mask strands; subsequently, the mask assembly is placed into an oven and heated to permanently adhere the permanent crosswires to the mask strands and also to remove the temporary guide members from the mask strands as the non-permanent adhesive volatilizes away.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view, partially in the axial section, of a color picture
5 tube, including a tension focus mask-frame-assembly according to the
present invention;

FIG. 2 is a perspective view of the tension focus mask-frame-
assembly of FIG. 1; and

FIG. 3 is a perspective view of the apparatus of the present
10 invention.

DETAILED DESCRIPTION

FIG. 1 shows a cathode ray tube 10 having a glass envelope 12
15 comprises a rectangular faceplate panel 14 and a tubular neck 16
connected by a rectangular funnel 18. The funnel 18 has internal
conductive coatings (not shown) that extends from an anode button 20
to a neck 16. The panel 14 comprises a viewing faceplate 22 of a
peripheral flange or sidewall 24 which is sealed to the funnel 18 by a
20 glass frit 26. A three-color phosphor screen 28 is carried by the inner
surface of the faceplate 22. The screen 28 is a line screen with the
phosphor lines arranged in triads, each triad including a phosphor line
of each of the three colors. A tension focus mask 30 is removably
mounted in a predetermined spaced relation to the screen 28. A
25 tension focus mask has a different voltage applied to the mask strands
and crosswires during tube operation. The electron guns (not shown in
the diagram) within the dashed lines 32 are centrally mounted within
the neck 16 to generate three in-line electron beams, a center beam and
two side beams, along convergent paths through the mask 30 to the

screen 28.

The tube 10 is designed to be used with an external magnetic deflection yoke, such as the yoke 34 shown in the neighborhood of the funnel to neck junction. When activated, the yoke 34 subjects the three
5 beams to magnetic fields which cause the beams to scan horizontally and vertically in a rectangular raster over the screen 28.

The tension focus mask 30, shown in greater detail in FIG. 2, includes two long sides 36 and 38 and two short sides 40 and 42. The two long side borders 36 and 38 of the mask are parallel to a central
10 major axis, x, of the tube and perpendicular to a central minor axis, y. The tension focus mask 30 includes two sets of conductive members: mask strands 44 that are parallel to the central y axis and to each other; and crosswires 46, that are parallel to the central major axis x and to each other. In a preferred embodiment, the mask strands 44 are flat
15 strips that extend vertically (parallel to y axis), having a width of about 0.015 inches and a thickness of about 0.002 inches, and the crosswires 46 have a round cross section, having a diameter of 0.001 inches and extend horizontally (parallel to x axis). In the completed mask, the mask strands, which are held in tension, and crosswires are separated from
20 each other by suitable insulator layers such as a lead-based frit.

FIG. 3 illustrates the tension focus mask 30 with the novel non-permanent horizontal guide members 302 on the first side, or otherwise known as gun-side, of the tension focus mask 30. The guide members 302 maintain the uniform spacing between the mask strands 44 during
25 the application of the permanent, horizontal crosswires 46 onto the second side, or otherwise known as the screen-side, of the tension focus mask 30. The mask frame 306 of the tension focus mask 30 includes two long sides 36 and 38, which contain cantilevers 304 to which the vertical mask strands 44 are attached. The mask frame 306 further contains two

short sides 40 and 42 which contain busbars 308. Busbars 308 are structural components to which the crosswires 46 are terminated. The mask strands 44 are positioned such that the last gap near the busbar 308 is well-controlled, similar to the space between each of the vertical mask strands 44. The novel non-permanent guide members 302 are attached so as to stabilize and maintain the uniform spacing of the mask strands 44 and to provide a measure of stability during the crosswire 46 application process. The guide members 302 may be of any suitable cross-sectional shape, such as a flat, thin member or a cylindrical member. Examples include a flat, thin member which can have a thickness of 0.002 inches and a width of 0.015 mils or cylinder shape which can have a diameter of 0.005 inches. These non-permanent guide members 302 are then attached to a first side, or otherwise known as the gun-side, of the focus tension mask 30 prior to the crosswire application. The guide members 302 are attached by means of an organic adhesive such as an acrylic resin dissolved in a suitable solvent, such as amyl alcohol. Such adhesives have low bake-out temperatures which later allow for easy removal of the guide members 302 during a thermal cycle. After the guide members 302 are attached, the screen-side crosswires 46, are applied on top of the mask strands 44.

Under normal processing, the mask strands 44 would be displaced or distorted during the application process. However, the guide members 302 prevent the displacement of the mask strands 44 during the crosswire 46 positioning and attachment process. The crosswires 46 are adhered to the second side of the mask through the use of an insulating adhesive layer. A suitable method for adhering the guide members 302 and crosswires 46 is as follows: (1) a base coat of an insulator material such as a lead-based frit is applied to the second side of the mask; (2) the mask is baked; (3) a top coat of an insulator material

such as a lead-based frit is also applied to the second side of the mask;
(4) an adhesive is applied to the guide members 302 (5) the guide
members 302 are then positioned perpendicular to the strand 44 and
then adhered to the first side of the mask; (6) the crosswires 46 are then
5 applied onto the second side of the mask such that they are also
perpendicular to the mask strands 44; and (7) the assembly is then baked
so that the crosswires 46 are bound to the mask strands 44 by the cured
frit and that the adhesive on the first side of the mask volatilizes and the
guide members 302 detach.

10 During the heating process, which cures the frit, the guide
members 302 detach because the temperatures reached are sufficient
to bake-out the adhesive on the first side of the mask. A peak
temperature of 450°C is maintained for about 1 hour.

After the baking cycle is complete, the mask assembly is allowed to
15 cool. At approximately room temperature, the mask assembly is
removed from the oven unit and guide members 302 which have
detached are then discarded. The tension focus mask 30 is then checked
to make sure that the crosswires 46 have maintained their uniform
spacing during the baking process. After the check is completed, the
20 tension focus mask 30 is then ready for insertion into faceplate panel 14
and the subsequent assembly is processed in a cathode-ray tube 10 of
FIG. 1.

As the embodiments that incorporate the teachings of the
present invention have been shown and described in detail, those skilled
25 in the art can readily devise many other varied embodiments that still
incorporate these teachings without departing from the spirit of the
invention.

CLAIMS

1. A tension focus mask apparatus (30) in a color cathode ray tube (10), said tube having a faceplate (22) with color emitting phosphor stripe screen (28), a mask frame (306) having two cantilever support structures (304) and securing said mask frame on said faceplate adjacent said screen, a plurality of mask strands (44) being secured to said support structure in tension, said apparatus comprising;
at least one guide member (302) temporarily secured across said mask strands whereby said guide member causes said strands to maintain generally uniform spacing to permit registration with said color emitting phosphor; and
a plurality of crosswires (46) also secured to said mask strands.
2. The apparatus of claim 1, wherein the guide member is adhered with a first type of adhesive and the crosswires are adhered with a second type of adhesive where the first and second adhesives are different.
3. The apparatus of claim 2, wherein the first type of adhesive has different properties than the second type of adhesive.
4. The apparatus of claim 1, wherein the guide members are of a substantially flat.

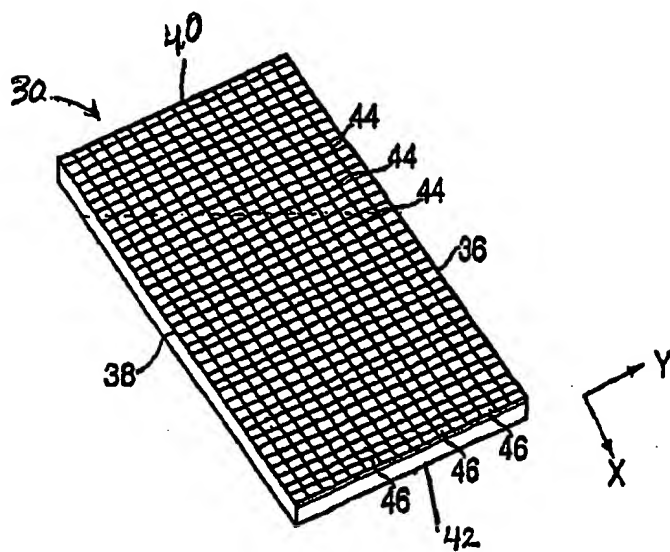
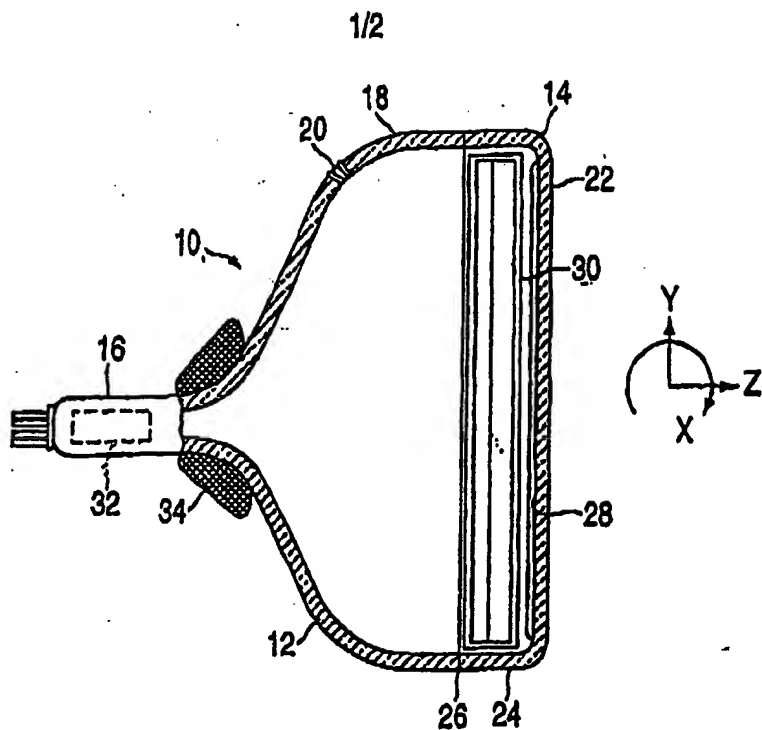
5. A method for use in the manufacture of a tension mask (30) having an array of mask strands (44) mounted in tension on a mask frame (306), the method steps, not necessarily in the stated order, comprising:

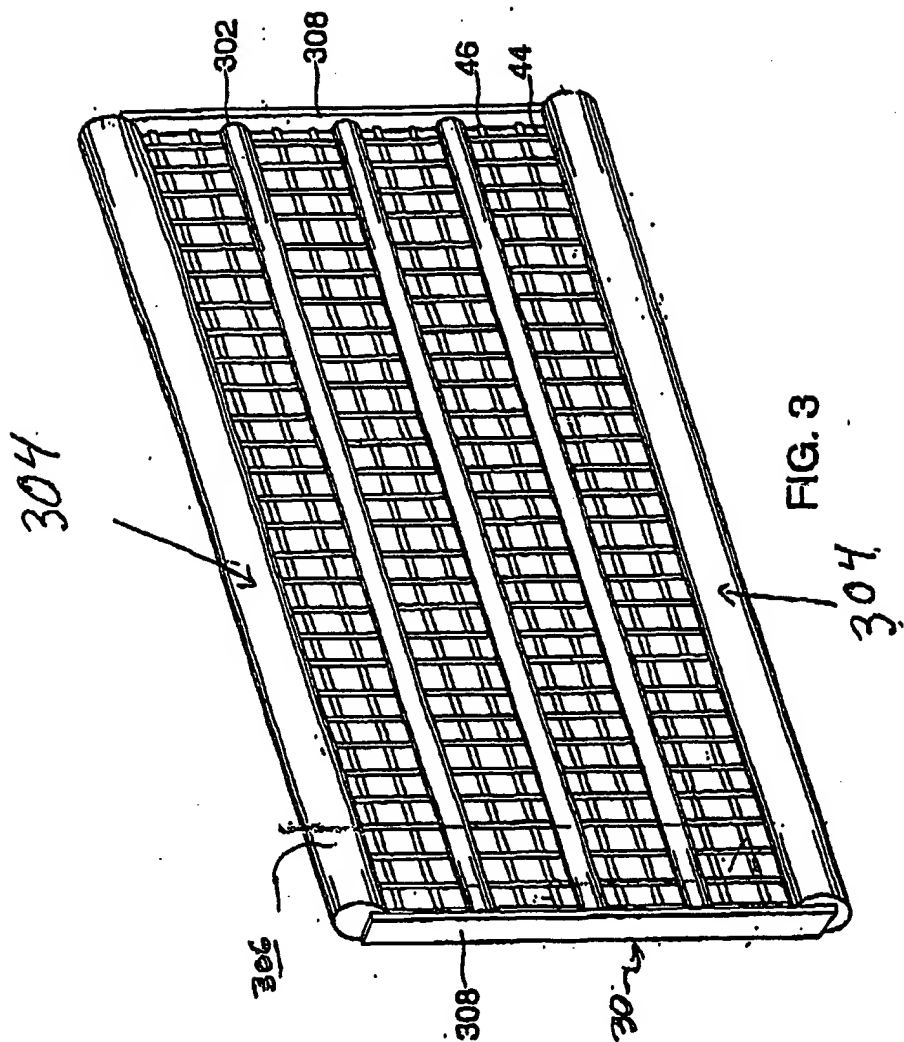
- 5 applying an insulating adhesive material to a second side of the exposed surface of said mask strands;
- temporarily attaching at least one guide member (302) to a first side of the exposed surface of said mask strands with an adhesive;
- affixing an array of electrically conductive crosswires (46) to said
- 10 second side across said mask strands wherein said crosswires and strands form a central pattern of apertures on the mask frame;
- heating said tension mask to bake out the adhesive and remove said guide members from said first side of said strands.

- 15 6. The method as described in claim 5, further comprising the steps of heating the tension mask after applying an insulator material to said second side of the exposed side of said mask strands.

7. The method as described in claim 6, further comprising the step of
- 20 applying a top coat of an insulating adhesive material to said second side of the mask strand after heating said tension mask.

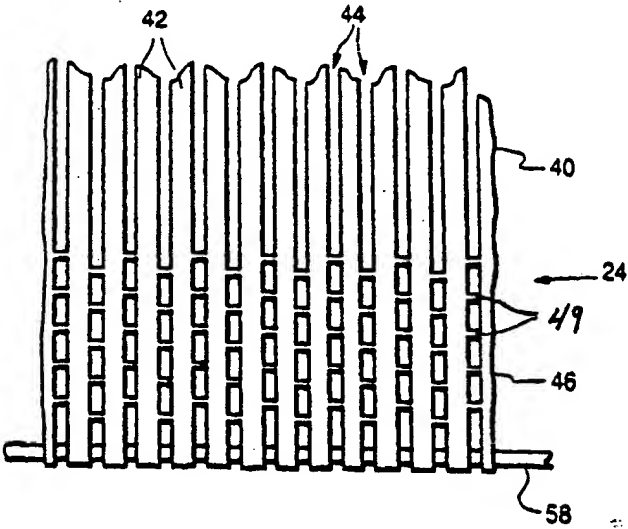
8. The method as described in claim 5, wherein the step of heating said tension mask further comprises heating to a temperature of 450°C
- 25 and holding at that temperature for about 1 hour.





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(54) Title: COLOR PICTURE TUBE HAVING A LOWER EXPANSION TENSION MASK ATTACHED TO A HIGHER EXPANSION FRAME  (57) Abstract <p>A color picture tube (10) has a tensioned mask (24) supported by a support frame (50) mounted within the tube. The mask has a significantly lower coefficient of thermal expansion than the frame. The mask has an active apertured portion (40) formed by a plurality of parallel vertically extending strands (42), through which electron beams pass during operation of the tube, and two opposite side border portions (46, 48) outside the active apertured portion. The two opposite side border portions have tie bars (49) that extend between the vertical strands of the mask. The tie bars accommodate expansion of the frame, while substantially maintaining the positions of the vertical strands in the active portion of the mask.</p>		

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COLOR PICTURE TUBE HAVING A LOWER EXPANSION TENSION MASK
ATTACHED TO A HIGHER EXPANSION FRAME

This invention relates to color picture tubes having tension masks, and particularly to a tube having means for connecting a tension mask, that is made of a material having a relatively low coefficient of thermal expansion material, to a support frame, that has a significantly higher coefficient of thermal expansion.

A color picture tube includes an electron gun for generating and directing three electron beams to the screen of the tube. The screen is located on the inner surface of a faceplate of the tube and is made up of an array of elements of three different color emitting phosphors. A color selection electrode, which may be either a shadow mask or a focus mask, is interposed between the gun and the screen to permit each electron beam to strike only the phosphor elements associated with that beam. A shadow mask is a thin sheet of metal, such as steel, that is usually contoured to somewhat parallel the inner surface of the tube faceplate.

One type of color picture tube has a tensioned shadow mask mounted within a faceplate panel thereof. In order to maintain the tension on the mask, the mask must be attached to a relatively massive support frame. Although such tubes have found wide consumer acceptance, there is still a need for further improvement in tube types to reduce the weight and cost of the mask-frame assemblies in such tubes.

It has been suggested that a lighter frame could be used in a tension mask tube if the required tension on a mask is reduced. One way to reduce the required mask tension is to make the mask from a material having a low coefficient of thermal expansion. However, a mask from such material would require a support frame of a material having a similar coefficient of thermal expansion to prevent any mismatch of expansions during thermal processing that is required for tube manufacturing, and during tube operation. Because the metal materials that have low coefficients of thermal expansion are relatively expensive, it is relatively costly to make both the mask and frame out of identical or similar materials. Therefore, it is desirable to use the combination of a lower expansion tension mask with a higher expansion support frame. The present invention provides a solution to the problem that exists when there is a substantial mismatch in coefficients of thermal expansion between a tension mask and its support frame.

The present invention provides an improvement in a color picture tube having a tension mask supported by a support frame mounted within the tube. The tension mask has a significantly lower coefficient of thermal expansion than that of the frame. The mask includes an active apertured portion formed by a plurality of parallel vertically extending strands, between which are elongated apertures through which electron beams pass during operation of the tube. Two opposite side border portions, outside the active apertured portion, have tie bars that extend between the vertical strands of the mask. The tie bars

accommodate expansion of the frame, while substantially maintaining the positions of the vertical strands in the active portion of the mask.

In the drawings:

FIGURE 1 is a side view, partly in axial section, of a color picture tube embodying the invention.

FIGURE 2 is a front view of a tension shadow mask.

FIGURE 3 is a front view of a small section of a border portion of the mask of FIGURE 2.

FIGURE 4 is a perspective view of a corner of a tension shadow mask-frame assembly.

FIGURES 5 through 11 are front views of small sections of six different alternative embodiments of tension mask border portions.

FIGURE 1 shows a color picture tube 10 having a glass envelope 11 comprising a rectangular faceplate panel 12 and a tubular neck 14 connected by a rectangular funnel 15. The funnel 15 has an internal conductive coating (not shown) that extends from an anode button 16 to the wide portion of the funnel and to the neck 14. The panel 12 comprises a substantially flat external viewing faceplate 18 and a peripheral flange or sidewall 20, which is sealed to the funnel 15 by a glass frit 17. A three-color phosphor screen 22 is carried by the inner surface of the faceplate 18. The screen 22 is a line screen with the phosphor lines arranged in triads, each triad including a phosphor line of each of the three colors. A color selection tension shadow mask 24 is removably mounted in predetermined spaced relation to the screen 22. An electron gun 26, shown schematically by dashed lines in FIGURE 1, is centrally mounted within the neck 14 to generate and direct three inline electron beams, a center beam and two side beams, along convergent paths through the mask 24 to the screen 22.

The tube 10 is designed to be used with an external magnetic deflection yoke, such as the yoke 30 shown in the neighborhood of the funnel-to-neck junction. When activated, the yoke 30 subjects the three beams to magnetic fields which cause the beams to scan horizontally and vertically in a rectangular raster over the screen 22.

The tension shadow mask 24, shown in FIGURES 2 and 3, includes two long sides 32 and 34, and two short sides 36 and 38. The two long sides 32 and 34 of the mask parallel a central major axis, X, of the mask; and the two short sides 36 and 38 parallel a central minor axis, Y, of the mask. The tension shadow mask 24 includes an active apertured portion 40 that contains a plurality of parallel vertically extending strands 42. A multiplicity of elongated apertures 44, between the strands 42, parallel the minor axis Y of the mask. The electron beams pass through the apertures 44 in the active portion 40 during tube operation. Each aperture 44 extends continuously from a border portion 46 at a long side 32 of the mask to another border portion 48 at the opposite long side 34.

A frame 50, for use with the tension shadow mask 24 is partially shown in FIGURE 4. The frame 50 includes four sides: two long sides 52, substantially paralleling the major axis X of the tube, and two short sides 54, paralleling the minor axis Y of the tube. Each of the two long sides 52 includes a rigid section 56 and a compliant section 58 cantilevered from the rigid section. The rigid sections 56 are hollow tubes, and the compliant sections 58 are metal plates. Each of the short sides 54 has an L-shaped cross-section upper portion 60 parallel to and separated from a flat bar-shaped lower portion 62. The two long sides 32 and 34 of the tension mask 24 are welded to the distal ends of the compliant sections 58. Although the present invention is described in embodiments using the frame 50, it is to be understood that many other types of tension frames could also be used with the present invention.

The strands 42 are continued from the active portion 40 into the border portions 46 and 48, where they are connected by tie bars 49, which interrupt the continuation of the apertures 44, as shown in FIGURES 3 through 10. The tie bars 49 in adjacent columns are vertically offset from each other, so that no two tie bars in adjacent columns have horizontally aligned centerlines. The strands 42 also extend beyond the border portions 46 and 48, where they are individually welded to the frame.

The purpose of the tie bars 49 in the border portions 46 and 48 of the mask 24 is two-fold. First, the tie bars 49 accommodate undesirable strand positioning errors that occur when individual strands are welded to the compliant section 58. Such individual strand attachment is required to avoid inelastic deformations that would be produced during thermal processing of mask-frame systems, wherein the mask and frame have considerably different coefficients of thermal expansion and the mask has a solid border in the weld zone, as is known in the art. When a low-thermal expansion mask with a solid border is affixed to a high-thermal expansion compliant section 58, thermal processing of the tube, which can reach temperatures as high as 450°C, can cause the mask to be inelastically stretched in the solid border region, and upon cool-down the mask wrinkles. In the absence of a solid border region, tie bars 49 assure that the desired strand spacing is maintained during welding.

The second purpose for the tie bars 49 is to accommodate the greater expansion of a high expansion frame 50 compared to that of a low expansion mask 24, without causing appreciable relocation of the mask strands 42 through permanent deformation of the mask border portion. The tie bars 49, together with the strand sections they interconnect, generally achieve this result by elastically stretching near the active portion of the mask. A key objective of all border treatments disclosed herein, wherein masks and frames are constructed of dissimilar materials, is to provide strand-to-strand spacing means when welding individual strands or small groups of strands, such that the mask can withstand the customary thermal processing of the tube without the formation of inelastic deformations that would result in errors in strand-to-strand openings.

Other embodiments of mask borders having different tie bar patterns are shown in FIGURES 5 through 11. In a mask 64, shown in FIGURE 5, tie bars are omitted near the compliant section 58. In a mask 66, shown in FIGURE 6, the tie bar positions are repeated every third column instead of every second column, as is done in the pattern of FIGURE 3. 5 FIGURE 7 shows a mask 68, wherein the spacing between tie bars is increased. FIGURE 8 shows a mask 70, wherein the repeat distance between tie bars is varied between adjacent columns. FIGURE 9 shows a mask 72, wherein a large tie bar is inserted in every other column. FIGURE 10 shows a mask 74, wherein every fourth column includes a large tie bar and the three intermediate columns do not have any tie bars near the compliant section 58. 10 FIGURE 11 shows a mask 76 having a border portion similar to that shown in the mask 24 of FIGURE 3, but an active portion 40 having widely spaced tie bars 78 connecting the strands therein. Alternatively, the vertical spacing between the tie bars 78 in the active portion 40 could be the same as the vertical spacing between tie bars in the border portion 46. Also possible are additional mask embodiments, which have border portions that include 15 tie bars. Preferably, the centerlines of tie bars in adjacent apertures are vertically offset.

In different embodiments, the vertical spacings between tie bars are in the range of 2.03 mm (80 mils) to as much as 76.96 mm (3030 mils). However, vertical spacings of tie bars of 2.54 mm (100 mils) to 4.06 mm (160 mils) are preferred. Generally, tie bar thickness of about 0.38 mm (15 mils) is preferred, although thicknesses of 1.02 mm (40 mils) 20 are used in some embodiments. Preferably, the mask is made from Invar material that is 0.10 mm (4.0 mils) thick, and the frame is made of AK steel.

All known commercially used tension shadow mask tubes have had solid border portions at the mask-to-frame weld points. This was acceptable when the mask and frame were made from similar expanding materials. However, when a mask and frame differ 25 greatly in coefficients of thermal expansion, such solid border portions will deform, thereby permanently deforming the active portion of the mask during thermal processing of the tube. Individual attachment of the mask strands to the frame, in combination with the novel border portion of the present invention, prevents substantial distortion in the active portion of the mask by providing a "mechanical filter" that accommodates any individual strand attachment 30 error or movement during processing or tube operation.

CLAIMS

1. A color picture tube (10) having a tension mask (24, 64, 66, 68, 70, 72, 74, 76) attached to a support frame (50) mounted within said tube, comprising
said mask having a significantly lower coefficient of thermal expansion than that of
5 said frame, and
said mask having an active apertured portion (40) formed by a plurality of parallel
vertically extending strands (42), between which are elongated apertures (44) through which
electron beams pass during operation of said tube, and two opposite side border portions (46,
48), outside said active apertured portion, having tie bars (49) extending between said
10 vertically extending strands.
2. The color picture tube (10) as defined in claim 1, wherein said strands (42) are
separated at said frame (50) and individually welded thereto.
- 15 3. The color picture tube (10) as defined in claim 1 or 2, wherein centerlines of
said tie bars (49) within adjacent apertures (44) are vertically staggered.
4. The color picture tube (10) as defined in claim 1 or 2, wherein said strands
(42) have tie bars (78) therebetween in the active apertured portion (40) of said mask (76).
20
5. The color picture tube (10) as defined in claim 4, wherein the vertical spacing
between the tie bars (78) in the active apertured portion (40) is greater than the vertical
spacing between the tie bars (49) in the border portions (46, 48).
- 25 6. The color picture tube (10) as defined in claim 1 or 2, wherein said mask (24,
64, 66, 68, 70, 72, 74, 76) is made from Invar and said frame(50) is made from steel.

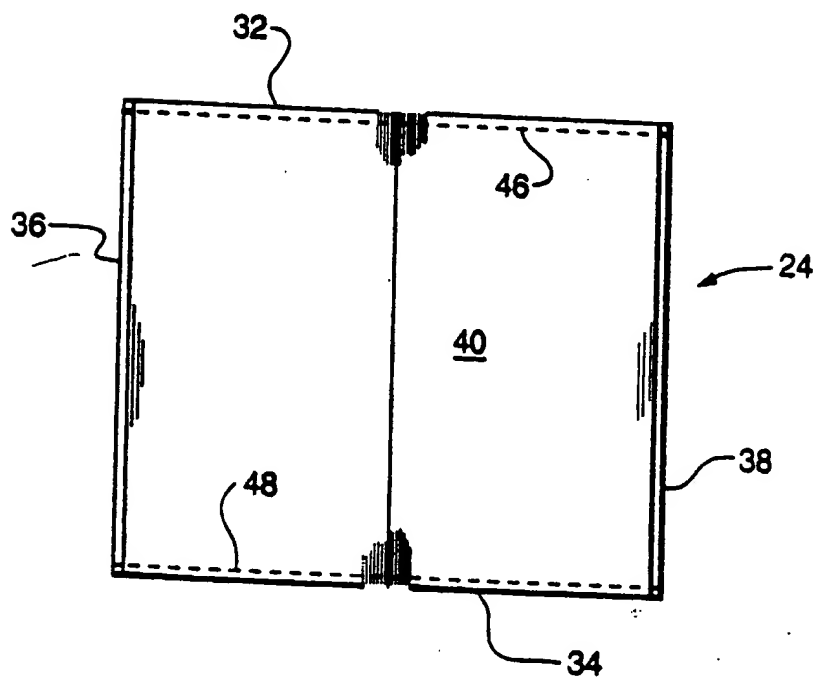
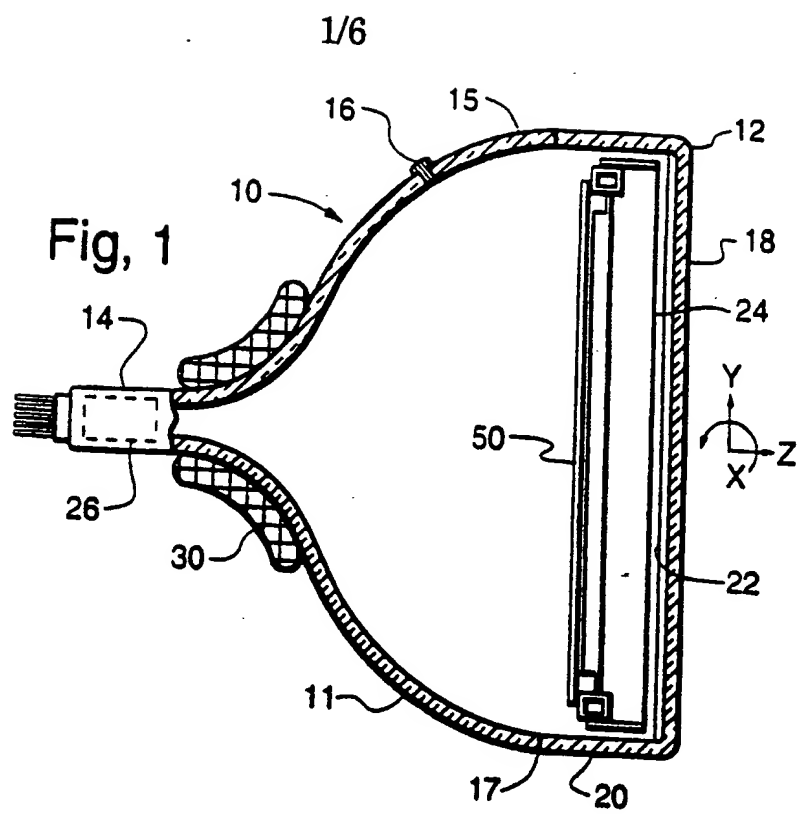
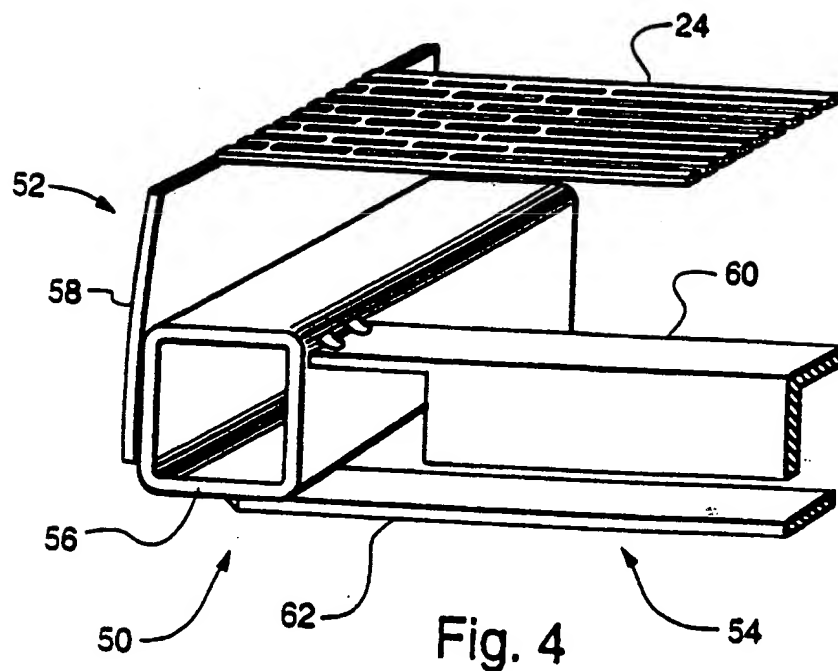
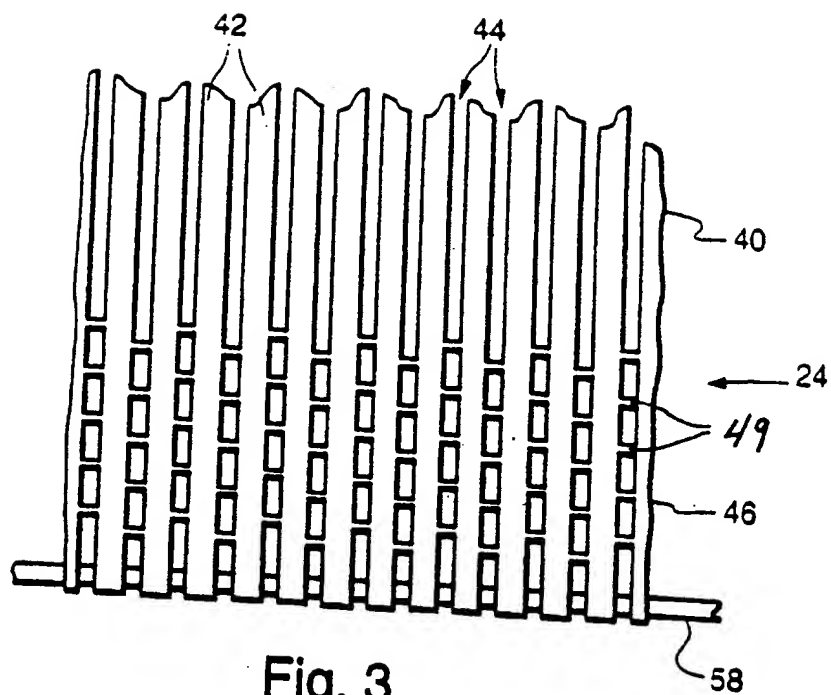


Fig. 2

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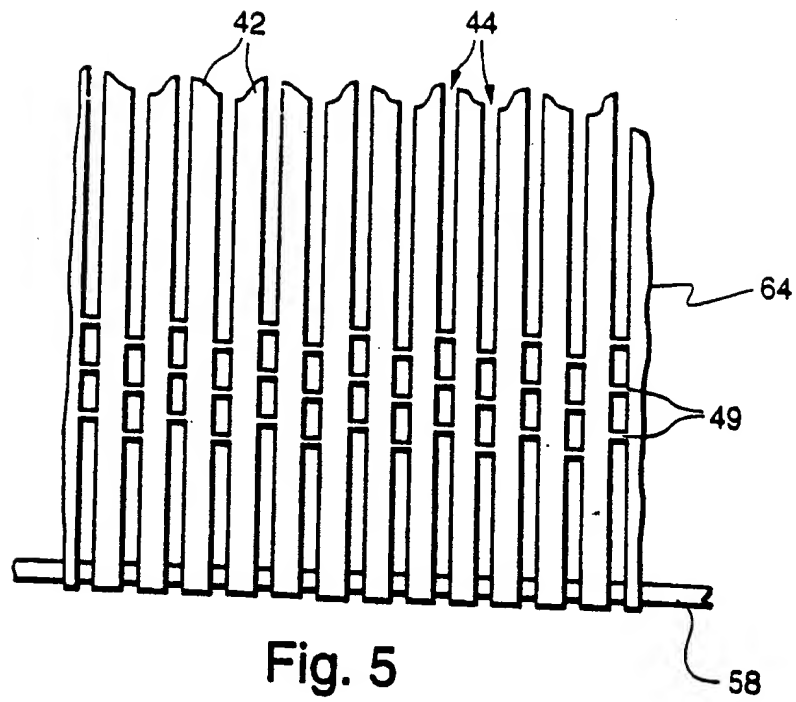


Fig. 5

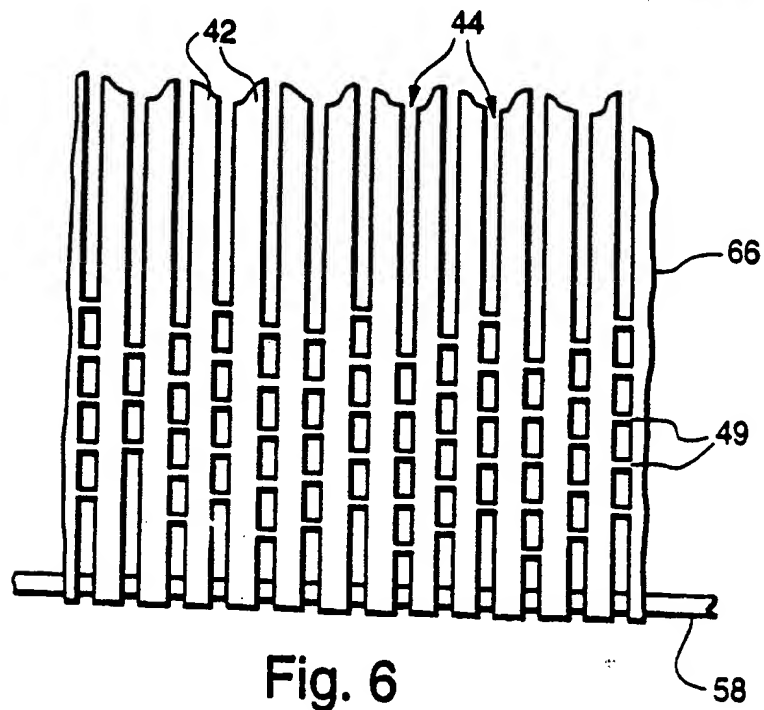
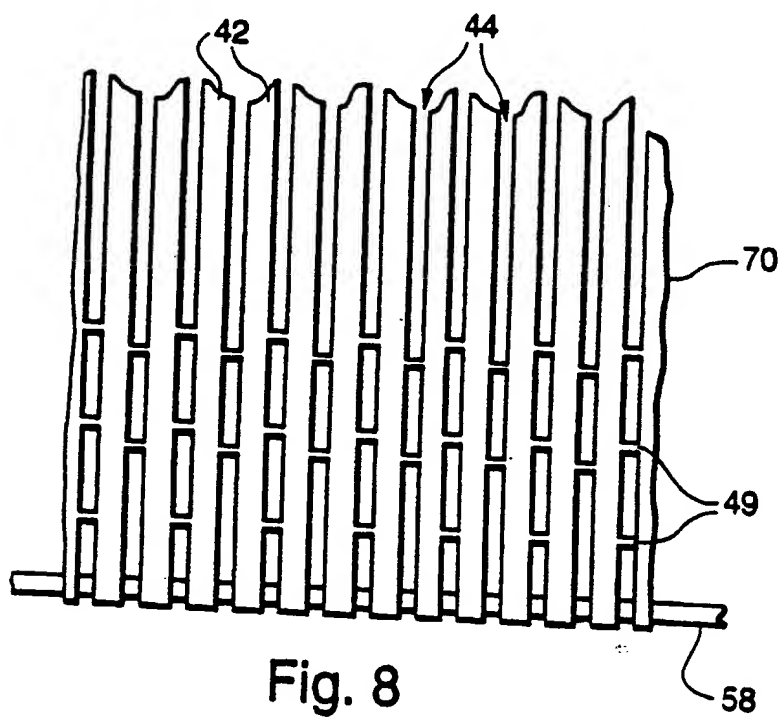
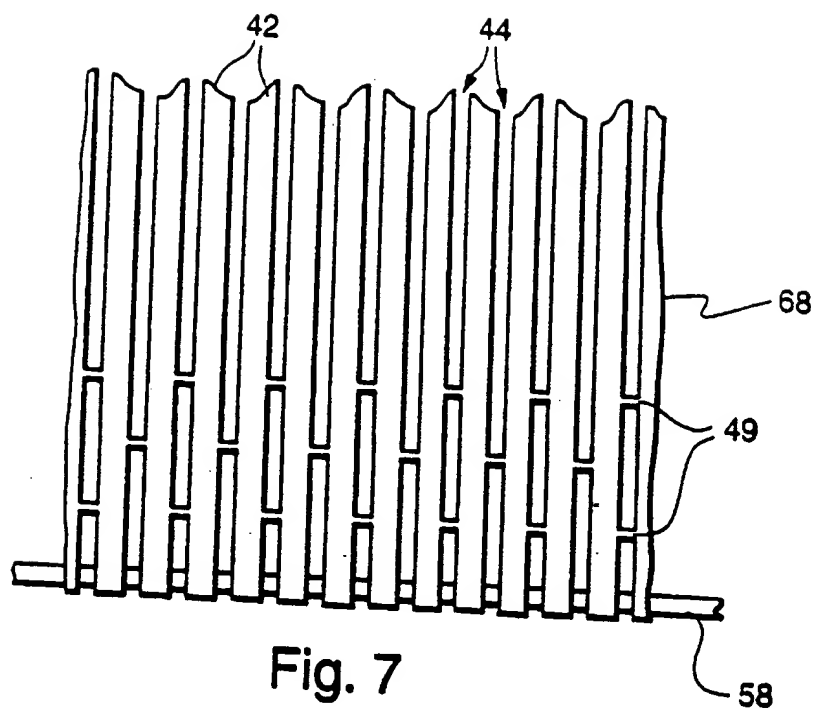
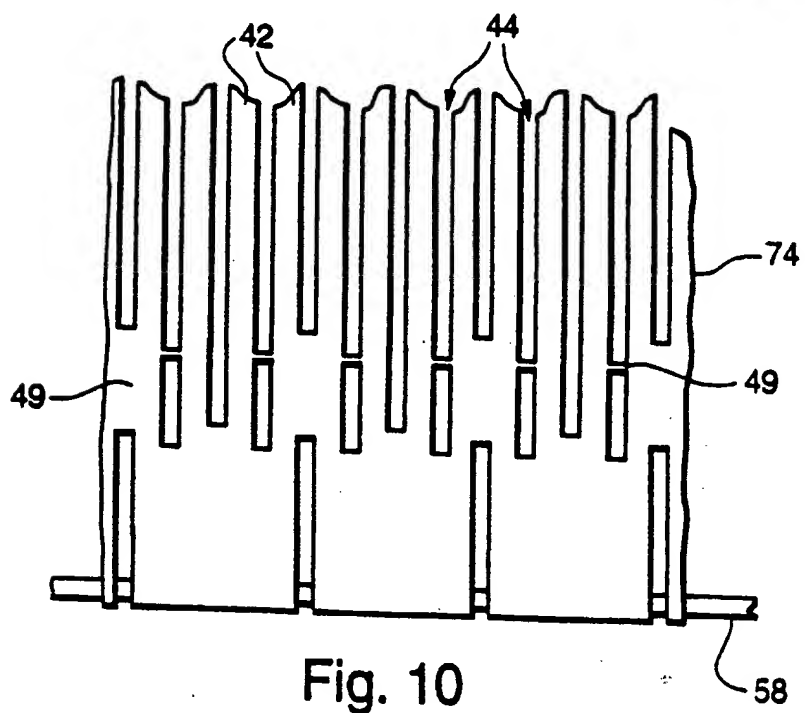
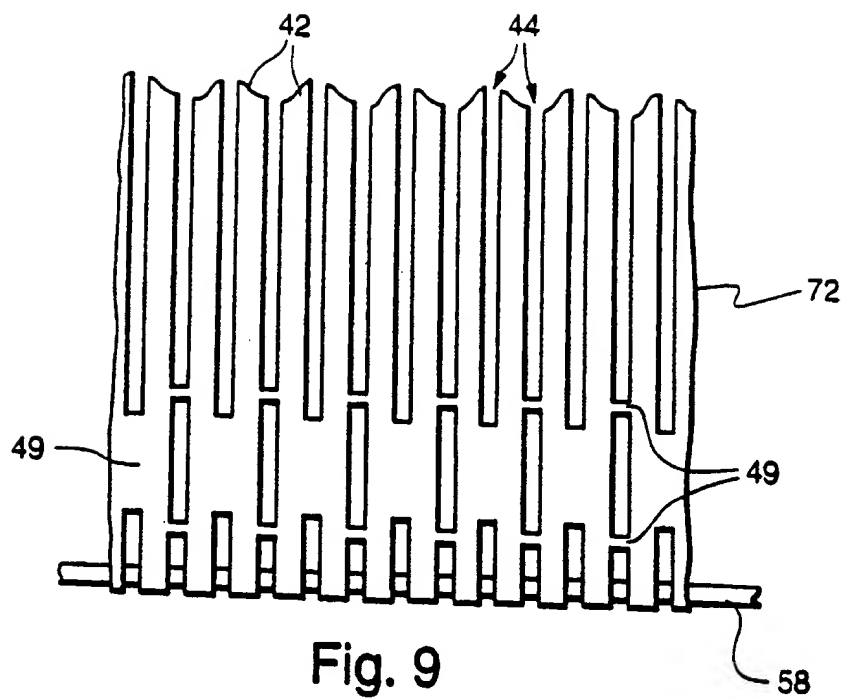


Fig. 6

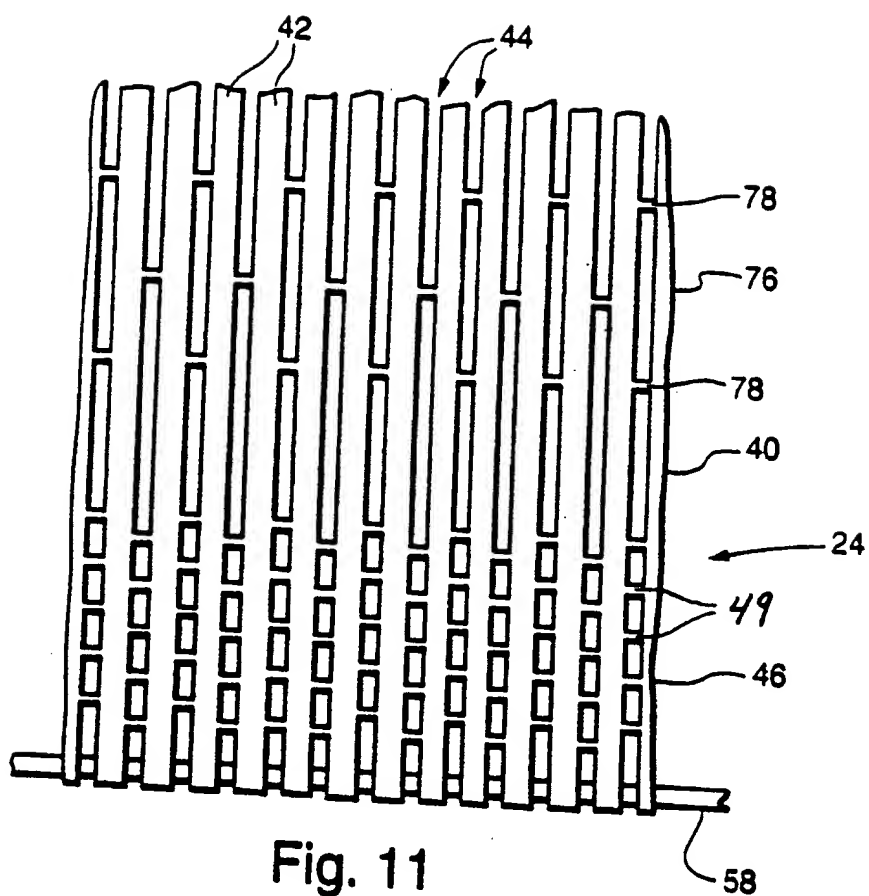
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INTERNATIONAL SEARCH REPORT

Int. l. Application No
PCT/US 00/08058

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01J29/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 602 620 A (SONY CORP) 22 June 1994 (1994-06-22) column 1, line 15 - line 23 column 4, line 51 - line 55 column 5, line 9 - line 16 column 5, line 30 - line 42	1
A	US 5 488 263 A (TAKEMURA TAKETOSHI ET AL) 30 January 1996 (1996-01-30) column 1, line 45 - column 2, line 14 column 7, line 48 - column 8, line 67	1
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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